SB 608
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AN

ESSAY ON PEAR-BLIGHT.

READ BEFORE THE

POTOMAC FRUIT-GROWERS' ASSOCIATION,

WASHINGTON, D. C.

By JEHU BRAINERD,

TOGETHER WITH AN INTRODUCTORY NOTE BY J. P. KIRTLAND, M.D.

COLUMBUS:
NEVINS & MYERS, BOOK AND JOB PRINTERS.
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PEAR-BLIGHT.

[The blight in pear trees is one of those singular phenomena which hitherto has defied successful investigation. The following article, contributed by Prof. Brainerd (formerly a professor in the Cleveland Homœopathic College, but during the past fifteen years occupying a very responsible and important position in the Patent Office in Washington), is so highly indorsed by Prof. Jared P. Kirtland, of the Cleveland Medical College, as to induce one to believe that if Prof. Brainerd's theory is not absolutely the true one, it is at all events much nearer the truth than any heretofore promulgated.

There is at this moment no one in Ohio who is the peer of Prof. Kirtland in vegetable physiology. During an active intellectual life, which has happily been extended to the full measure of four score years, he has been a vigilant and appreciative observer of every phenomenon of vegetable life which presented itself to him. To his intelligence and skill are we indebted for several of our choicest varieties of cherries, the "Gov. Wood," "Kirtland's Mary," and others. His successful experiments in budding, grafting, inarching, and hybridizing fruits, flowers, grapes, and berries are almost endless. A theory relating to diseases in the vegetable world must, therefore, have positive merit before it can receive such an affirmative commendation at his hands.—KLIPPART.]

PROF. KIRTLAND'S LETTER ON PEAR-TREE BLIGHT.

EAST ROCKPORT, OHIO, October 28, 1876.

PROF. JEHU BRAINERD, *Washington, D. C.:*

DEAR SIR: I have recently read your interesting and instructive report on "The Pear-Tree Blight." Allow me to congratulate you on having probably discovered the origin and nature of that malady, a malady that has hitherto baffled the investigations of the scientific and practical pomologists.

A knowledge of the pathology of a disease of the human system is often an important advancement towards effecting a cure or a prevention; a remark equally applicable to diseases of the vegetable kingdom.

In the summer of 1812, while pursuing the study of medicine in Hartford, Connecticut, a low and malignant fever appeared and spread extensively in that city. Athletic soldiers in the United States cantonment, as well as citizens, were frequently one hour apparently in the

enjoyment of perfect health, and in the next sinking into the arms of death, perhaps before remedies could be applied.

Coincident with the spreading of that epidemic among the human family, blight appeared extensively in the pear orchards. Trees were attacked of all ages, some dating back to provincial times, and of size equaling those occasionally met with at this day on the banks of the Detroit river, the remains of French planting in or before the times of Pontiac. Its attacks were as sudden as those of the sinking fever, and resulted suddenly in either the death of the trees or of extensive impairment. Public attention was greatly awakened by its ravages, and as ignorance of its cause prevailed, and in want of an explanatory hypothesis, the public generally concluded that it was the same pestilence which walketh in darkness that was alike laying its heavy hand on the people and the pear trees. This indefinite hypothesis prevailed for a time, till, in succession, it was displaced by that of insect depredation, frost impression, and fungoid poison. Neither of these suggested any practical means of relief from the evil. Since that period, sixty-four years, I have attentively watched the progress of the blight in different and remote parts of our country, and noted numerous facts bearing on the subject. Your views seem to embrace a well-founded theory of the cause of the disease, which indicates appropriate methods for preventing or counteracting it. More phenomena attending its rise and progress are thereby explained than by any or all the hypotheses hitherto advanced. I am happy to add that my own experience during that long interval of time, trivial as it may have been, sustains their correctness. If they be correct, of which little doubt can be entertained, it is highly important that they should be extensively diffused among practical pomologists.

No specific is at present known, yet evidences are not wanting that an energetic and persevering course of management will do much to remedy the evil of this disorder. The cultivator must take into consideration the character and selection of the variety of the fruit (Seckle and Winter Nellis rarely blight), the soil, and its condition in relation to drainage and moisture, special manures, cultivation or non-cultivation of the ground, shading and protection from the sun and from a south and southwestern exposure, mulching, freeing the bodies from old and rough bark, and washing annually with a solution of soda ash, correct pruning of the season's growth in autumn, and pinching off the top of each limb before the formation of the terminal bud, late in June, and other items too numerous to mention.

Incidentally, it may be added, that the cultivator should learn to gather his fruits at the moment the stem will cleave from the spur with-

out fracture, and to ripen them in a dry room. Each individual winter or autumn pear must be, immediately after gathering, wrapped in a separate paper, as oranges are preserved, and packed not over three layers deep, in either drawers, boxes, or crocks, placed in a dry and empty room. If the rind be allowed to wilt before the wrapping and packing be accomplished, the fine qualities of the variety will never develop.

Bishop Heber wrote that he found none of the East India fruits as palatable as those of temperate Europe. A Baron de Anjou, Dix, Lycurgus, or Winter Nellis, thus ripened, will favorably compare with the orange, guava, and pine apple of the tropics. Much is yet to be learned in the art and science of pear culture.

Very respectfully yours,

JARED P. KIRTLAND.

REPORT ON THE BLIGHT OF THE PEAR TREE.[a]

BY PROF. J. BRAINERD.

So far as I am able to learn, there is no settled theory in regard to the cause of the *Pear-Tree Blight*, and to my mind the discussion of subjects not definitely established accords perfectly with the ruling spirit of this Association, and when they are carefully considered can scarcely fail of some good results.

If our extreme modesty forbids the approach of such subjects, may it not be said that we fall short in the first and foremost object for which we are associated?

In order to comprehend the full significance of these observations, it will be necessary to call to mind some facts regarding the structure of plants and trees, and the phenomenon of the circulation of the sap.

In what is called *sap-wood* there is laid up in store soluble matter destined to contribute to the future development of the tree. This is clearly shown in the sugar-maple (*acer saccharinum*), and a knowledge of this fact is made available for obtaining a delicious sweet.

Sap is essentially a watery fluid, which the roots absorb from the earth, and contains or holds in solution a minute quantity of carbonic acid and ammonia and a few mineral constituents, drawn from the soil in a condition of solution in water.

In its ascending course, through the cells of the sap-wood, it meet with and dissolves a portion of the soluble cell-contents, and thus becomes

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[a] Read before the Potomac Fruit-Growers' Association, Washington, D. C., September 5, 1876.

more and more dense as it approaches the bud where it is appropriated to the development of the leaf, in which it undergoes a futher elaboration, and returns upon the outside of the sap-wood, to form a new growth, and in this condition is called *alburnum.*

In "Rhind's Vegetable Kingdom" this matter of sap circulation is fully examined. In this and other standard works on botany the fact that the ascending sap in *exogenous* trees passes upward through the growth of the previous years (hence called the sap-wood) is so universally admitted that its discussion here would be out of place.

The *alburnum*, then, is the layer or growth of the present year, that will form the sap-wood of the succeeding year. And this sap-wood may continue in activity for a number of years, and until the cells which form its structure become filled with mineral deposits, thereby becoming *heart-wood* and of no further use, so far as the vitality of the tree is concerned. It is, however, of value in giving strength to sustain the accumulating weight of the growth, but the vitality of the tree would not be affected by its removal.

Before I call attention to the sketches I have made, from microscopic examinations of the specimens submitted for that purpose at the August meeting, and since procured, it will be proper to examine, briefly, the anatomy of the growth under consideration.

The sap-wood is made up essentially of elongated cells, either joined end to end, or overlapping each other. During the growing season these cells are filled with crude sap of constantly increasing density from the spongiole of the root, where it is little else than water, to the extremity of the highest leaf.

In the leaf system it becomes elaborated sap, fitted for the formation, in its descent, of a system of new cells between the bark and the last year's growth, and which, when in the act of forming, is called alburnum, as before stated.

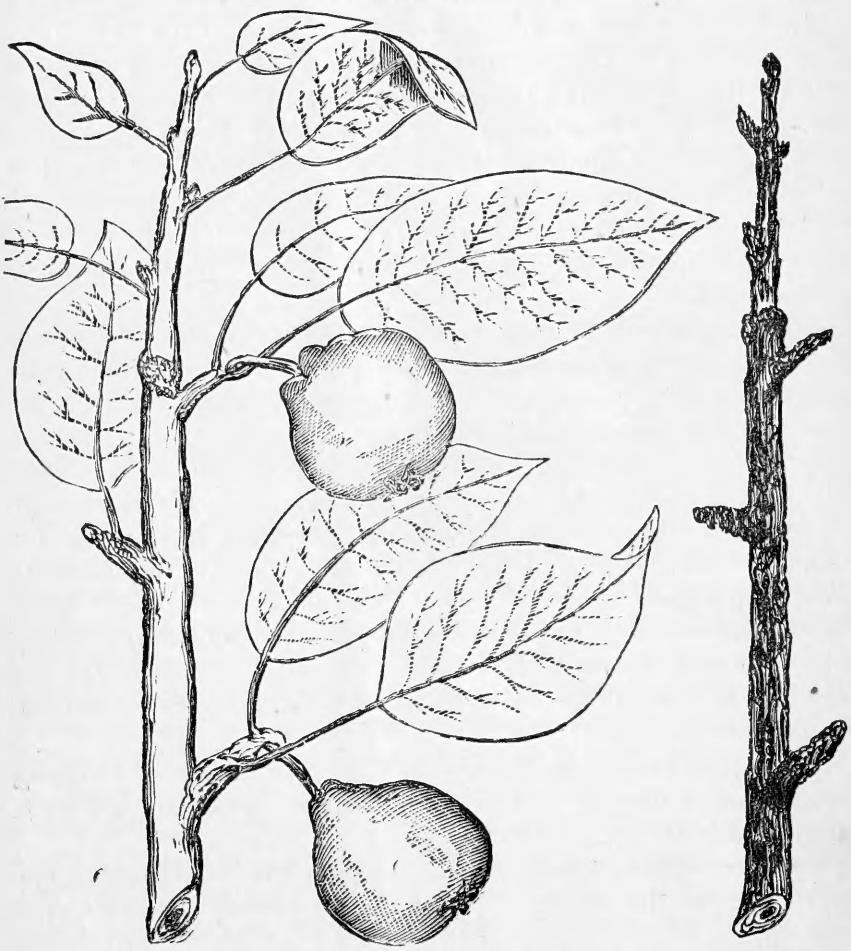
It is owing to the extreme delicacy and tenderness of these forming cells in the spring of the year that we, in our boyhood days, were enabled to make our "toy whistle of bark."

I will now call your attention to the possible causes of blight, and proceed to examine the sketches I have made from actual views under the microscope.

In an English work on " Practical and Scientific Fruit Culture, by Charles R. Baker," pages 420, 421, we find this significant statement: "That the enlargement of the flesh of a fruit, the entire or partial absence of seeds, are the result of *disease*, strictly considered; and yet these conditions are very desirable in fruit culture."

What we are to understand by the term *disease*, in this statement, must be held to relate wholly to the vitality of the tree, for it is a well-known fact that in fruits, as well as in animals, an excessive development in any particular direction—the fostering of favorite qualities—weakens the power of resistance against the vicissitudes of climate and the numerous natural foes to longevity, producing what may properly be termed an *anœmic* condition of the tree.

FIG. 1.



NATURAL SIZE—SOUND BRANCH, AND SAME BLIGHTED.

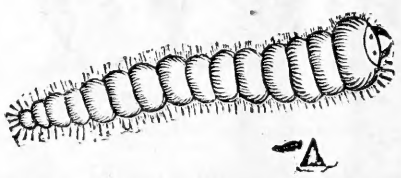
When I entered upon this examination, I was inclined to attribute the blight to the depredations of some species of insects, but I determined to conduct the investigation without bias; I could not, however, pass over this point without due consideration.

I therefore made diligent search for evidences of this character, but found none, with the exception of two or three spurs in perhaps fifty examined, in which appeared slight evidences of the work of the Pear-Blight Beetle, *Scolytus pyri.* This insect, which is very small, causes a blight of spurs and small twigs, which, in its outward appearance, resembles the common pear-tree blight.

The limbs or spurs attacked turn black and die, while other parts of the tree remain healthy. The egg of the insect is laid in the axil of the bud; the larva eats its way inward through the alburnum, and forms a circular passage in the sap-wood, thus cutting off the vessels for the ascending sap; the whole part above, being deprived of nutriment, dies.

I am satisfied, from a most careful examination, that the kind of blight under investigation is not caused by this nor any other insect, for I failed to find either the grub or the conditions above stated.

Since writing the foregoing paragraph, I have succeeded in finding the living larva of two individual specimens of *Scolytus pyri.* The branches



NATURAL SIZE—LARVÆ OF THE SCOLYTUS PYRI, MAGNIFIED TWENTY DIAMETERS.

had been in my possession about ten or twelve days. At this stage of their development their length is about one-tenth of an inch, a reddish brown head, two short hooked mandibles, dark eyes, large thorax, fifteen articulations, two or three stiff hairs upon the sides at each articulation, body very light straw color, almost white, and semi-transparent. The point where the larva entered the bark is scarcely perceptible without a magnifying glass, appearing not larger than a puncture made with the point of a needle. Their course is first inward, toward the pith from the base of the spurs, thence downward along that soft tissue. The discovery of these living larva should not be taken as evidence of a cause of the blight, inasmuch as their development was subsequent to the blight.

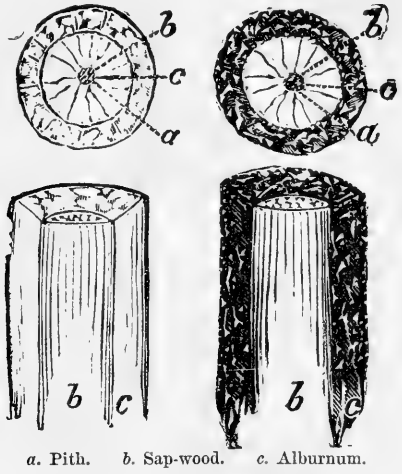
That the egg of the insect was deposited previously to, or about the time of the occurrence of, the blight is quite probable, but the tree had sustained no injury from the larva at that time.

We must, therefore, look for other causes, and in doing this we can have no more reliable guide than the revelations of the microscope.

I next turned my attention to the discovery, if possible, of a *fungoid* growth, by many regarded as the cause of blight. But, upon the closest

scrutiny, no evidence of this character appeared. I am, therefore, forced to the conclusion that fungus, whenever it does appear, is the consequence, and not the cause, of blight.

FIG. 2. FIG. 3.



a. Pith. *b*. Sap-wood. *c*. Alburnum.

NOT BLIGHTED. BLIGHTED BRANCH.

(Both magnified two diameters.)

I now call your attention to the microscopic views which I have prepared with scrupulous fidelity to the specimens before me.

Figure 1 shows a healthy and a blighted branch.

Figure 2 shows cross and longitudinal sections of the healthy branch magnified.

Figure 3 shows a like view from a blighted branch.

Figure 4 shows a slightly magnified branch blighted twenty-four hours previous to examination. The entire growth above the blighted portion was green and vigorous, showing a continuous supply of ascending sap, while the bark and alburnum in the blighted portion was dark and withered.

Figure 5 shows magnified vertical sections of healthy and blighted branches.

Figure 6 shows magnified views of *stomata*, in the green bark of the young shoot, both natural and blighted, with cross-section of the same.

In these examinations but one conclusion can be entertained, and that is, that the newly formed cells in the alburnum have, from some cause, been ruptured, and the elaborated sap, destined for the support of the fruit and the perfecting of the new growth of wood, poured out into the interspaces of the cells, coagulated and disorganized, producing in the

vegetable tissue a condition analagous to what is termed *extravasation* of blood in the animal tissue.

A comparison of the healthy alburnum with that struck with the blight shows most clearly that this statement is fully borne out by the facts in the case.

The microscopic appearance of the coagulated sap in the blighted portions of the stem, under a high magnifying power, was most remarkable.

Every vestige of cell formation was destroyed, and nothing could be seen but a dark coagulated mass, pushed out in rough masses through fissures in the bark; and this appearance extended through the whole thickness of the alburnum, while the sap-wood remained in a perfectly healthy state, conveying sap to the unblighted portions above, as seen in figure 4. The color of this coagulated sap presented all shades, from a pearly luster to a dark brown, presenting many irregularities and cavities, caused by contraction from loss of watery fluid.

The external bark and leaves appeared as though they had been scorched in a fire; hence the disease is aptly called "Fire Blight."

There are two causes that produce the rupture and destruction of newly formed cells in the alburnum, and the action is very sudden and certain. These are extremes of heat and cold. In the spring of 1875, in Ohio and along the lake shore fruit region, after the trees had put forth their leaves, a sudden fall of temperature from summer heat to twelve or fifteen degrees below freezing killed outright nearly every pear tree in that extensive fruit district.

I examined many trees soon thereafter, and found the external appearances exactly similar to what is called the "Fire Blight;" that is, the trees had the appearance of having been roasted in an oven.

The green and tender portions of the tree, especially the alburnum, are made up of cells whose membranous walls are very thin and delicate, and when the sap with which these cells are always filled is subjected to sudden expansion, from either high or low temperature, the cell-walls become ruptured, and the sap, of course, runs out and is diffused among the tissues, and its nutritive action is lost.

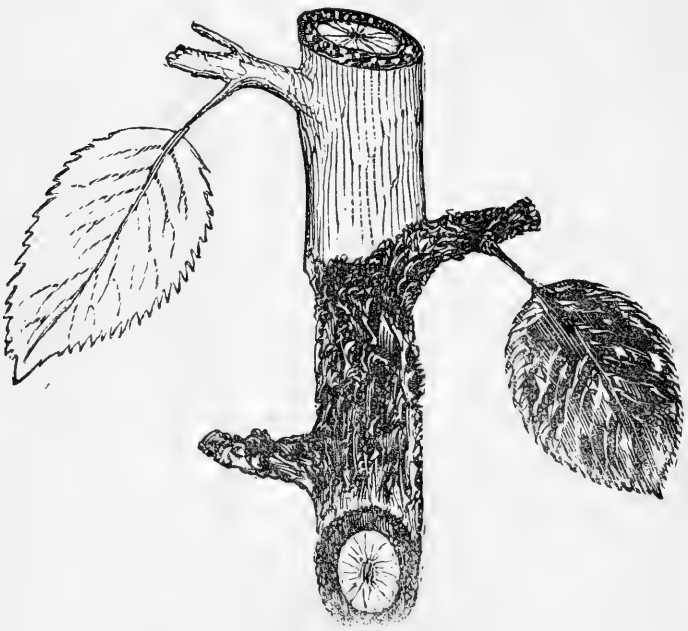
A putrefactive condition soon follows, giving rise to fungoid growth, if other conditions are favorable.

In order to test thoroughly the influence of heat, I subjected a vigorous and healthy branch of a pear tree to an artificial heat of 108 degrees Fah. for twenty minutes. The effect upon the leaves and soft tissues was exactly like that of the natural blight.

The normal heat for the fruit-producing season ranges from 65 degrees to 85 degrees Fah., the mean of which is 70 degrees.

A temperature of 95 degrees is dangerous, and 100 degrees to 108 degrees is disastrous.

FIG. 4.



BLIGHTED BRANCH, SHOWING HEALTHY SAP-WOOD, GIVING SAP TO UPPER BRANCHES.

A curious fact has been observed, and thus far not accounted for, and that is, the tendency of the blight to go in streaks through the orchard or nursery, sometimes being confined to a belt of a few feet in diameter, and the course of the blasting current of hot air is generally at right angles with the direct rays of the sun.

For example, if the injury is sustained in the afternoon, the direction of the wave will be from north of west to south of east. (BAKER.)

The alburnum, or forming wood, being made up of cells exactly like those of the sap-wood, but tender and delicate in structure, when becoming gorged with sap from excessively favorable conditions of grow h possess not the power to resist the pressure of the expanding sap under an almost tropical solar heat, oftentimes increased in intensity by the situation of the ground.

From careful observation and inquiry, I have found that orchards, or single trees, upon a southern exposure are much more liable to the blight than those on northern exposures.

As corroborative of this, I will state that I have seventy-five pear trees

in Prince George's county, Maryland (Duchess and Bartlett), now six years old, on a northern exposure; none of them are blighted.

Dr. Palmer, of this city, has an orchard of about forty pear trees, about two miles north of the boundary line, on the Bladensburg road, on a northern exposure, and no blight has touched them, while half a dozen trees on a southern slope of the land, upon the same farm, have been completely destroyed by the blight.

Dr. Breed had pear trees on a southern aspect, and they were all affected with the blight. He removed them to ground sloping toward the north, and they soon became healthy, fruitful, and no blight has since touched them.

Newton Crawford, Esq., of Bladensburg, has pear trees on ground facing the south; they are all ruined this year by the blight.

Mr. Throckmorton, of Virginia, about the tenth of August, brought me branches of a pear tree, in full bearing, which had been planted in a hollow left in leveling an old fort, where it was exposed to excessive heat, with water standing about its roots after a heavy rain. The tree flourished in the early part of the season, and on the first week in August was in a fine condition and full of fruit. It was struck with blight on one of the hottest days, about the fifth of the month, and in two days was completely withered. Other pear trees of the same age, standing on the northern side of the hill remain in full vigor to this day.

FIG. 5.—LONGITUDINAL SECTIONS.

a. Alburnum. *b*. Sap-wood. *c*. Pith.

NOT BLIGHTED. BLIGHTED.

Besides these instances, many others might be given, extending over a wide range of country, but these, it must be admitted, tend strongly to confirm our theory.

By reference to "Rhind's Vegetable Kingdom," it will be seen that the pear tree is indigenous to the northern sections of the temperate zone, flourishing in its native forests, as far north as fifty-seven degrees of latitude.

It seems to delight in a northern aspect, or at least is most hardy and long-lived when growing in positions where it is protected from intense solar heat.

In attempting to acclimate it to a warmer climate, its primitive habits should be regarded, and situations selected for its growth that will most promote its successful cultivation.

In the culture of fruit of any kind that is subject to maladies, and especially to fatal ones, which so often blast the hopes of the fruit-grower, it should be the first object to discover the cause, and then there is a better prospect of being able to find and apply a remedy.

It is undoubtedly true that grafting upon seedling stocks, raised from the seeds of highly cultivated fruit, greatly weakens the vitality of the tree; that is, the stock is feeble, and the roots do not strike vigorously into the soil, and when, by reason of the excessive demand for material to supply the requisite pabulum for the development of the choicest fruit, the roots soon become inadequate to furnish that supply, and a failure is the inevitable consequence; and, besides, a sickly tree, although planted in a favorable situation, is much less able to withstand the attack of an enemy than one in vigorous health.

Another evil we have to contend with is deep cultivation around the roots of the growing tree.

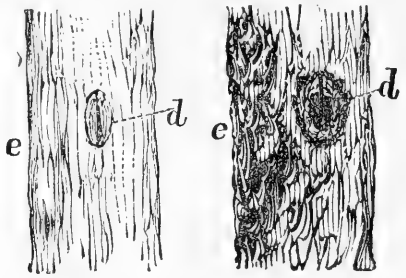
The roots of the pear tree, especially those highly cultivated, run near the surface of the ground. Deep plowing around the tree cuts off the roots that supply nourishment.

In a recent conversation with Mr. Munsell, a successful fruit-grower of Chardon, Ohio, I learned that he has greatly improved his pear trees, smitten with the blight, by carefully digging about the roots, taking care not to injure them, and mulching with mineral coal ashes and broken bones, mixed with good soil, at the same time digging a deep trench around the trees at the extremity of the roots, for the purpose of drainage and filling it with broken bones and coal ashes. Trees thus treated became healthy and fruitful.

Their situation was on high ground, nearly level, clay soil; the general slope of the land north, toward Lake Erie.

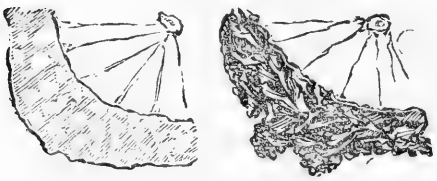
Fruit trees, to become vigorous and fruitful, must have the conditions, soil, and culture necessary to their successful development.

FIG. 6.



d. Stomata. *e.* Young twig.

NATURAL STOMATA. BLIGHTED STOMATA, FOUR DIAMETERS.



Neither the forming tissues of the wood nor the substance of the fruit can become perfect unless the carbon, hydrogen, nitrogen, sulphur, phosphorus, alkalies, and other elements are liberally supplied to the roots in due proportions and conditions fitted for absorption.

To insure a healthy growth and fruitage, and at the same time guard against the blight and other diseases to which the pear tree is subject, certain sanitary measures must be observed.

The most important of these is situation. A north or north-east slope of land is the most favorable, all other things being equal, for the reason that the solar heat culminates an hour or two after meridian, usually from one to two o'clock in the afternoon.

Deep cultivation and underdrainage before planting the trees should be secured. For pear trees a deep, loamy soil, with abundant moisture, but not an excess, is to be preferred. Top-dressing, with proper fertilizers, especially finely broken or ground limestone, should be freely used around the trees, as far as the roots extend.

Grafts from young, vigorous, bearing trees should be set upon the native crab or thorn. This will secure a strong and healthy root-growth; thus securing a constant and full supply of food from the commissary department of the tree. A horse would not thrive if stabled in a quagmire, and fed only upon ferns and sedge-grass. No amount of physic or grooming

would supply his natural wants. He must have good conditions and food. So with pear trees. If they are unfavorably located in an insufficient soil, with an aspect inviting destruction by the blight, all the sulphur and lime baths, whale oil soap-suds washes, and linseed oil liniments that can be applied will not save them.

All the therapeutic agents in the world will not bring to the tree the necessary conditions of health, prosperity, and usefulness.

In conclusion, I will remark that the evidences, to my mind, are conclusive that the blight of the pear tree is caused wholly by excessive solar heat, by which the tender and forming cells are ruptured, the elaborated sap poured out into the disorganized tissues, coagulated and dried, and consequently rendered unfit for the purposes of nutrition and growth.

And I believe that it will be found, upon further investigation, that the sections of the branches smitten have not been protected by foliage from the direct rays of the sun, while portions above the affected part, protected by leaves, have not been injured, but necessarily soon die from secondary causes.

If this hypothesis of pear-tree blight be the true one—and the accumulating evidence assuredly does point in that direction—then the remedy for this great evil must be sought, not in external applications to the injured parts, nor even by excision, but by planting in suitable soil, and in situations that will afford protection from the devouring heat.

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